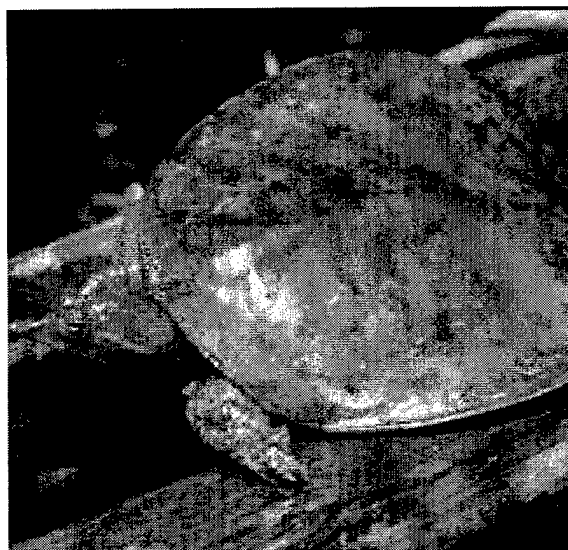


## Softshell Turtle Habitats Potentially Impacted by USACE Reservoir Operations

**BACKGROUND:** Changing water levels or other operations at U.S. Army Corps of Engineers (USACE) reservoirs may impact critical habitat parameters for softshell turtle species. This technical note identifies softshell turtle species and habitats potentially impacted by USACE reservoir or other water-control projects as reported by resource managers (Table 1). Current state and/or Federal legal protection status is summarized as is the distribution of USACE Districts and reservoir projects potentially impacted by softshell turtle conservation issues (Figure 1, Table 2). Life-history summaries and habitat requirement descriptions are given for each softshell turtle species identified as potentially impacted at reservoir operations. This group of peculiar-looking turtles includes four species with legal protection in at least one state and none with Federal protection status. Three of these species are associated with environmental issues at six USACE projects from three USACE Districts (3 USACE Divisions).



Smooth Softshell Turtle  
photo by Dena Dickerson

These turtles are widely distributed throughout the United States; however, the four species with state protection status primarily occur within the Mississippi and Ohio River watershed. Typical habitat is large rivers and streams with moderate to fast currents, soft or sandy bottoms, aquatic vegetation, and nearby sandbars. The softshell turtles were placed in a group separate from the riverine turtles because of certain behaviors unique to these turtles (i.e. burying in the soft bottom with only the head and neck protruding) and their peculiar physical characteristics. Softshell turtles are predominantly carnivorous; however, plant matter is sometimes consumed. Habitat destruction and overharvesting for food have contributed to significant reductions in populations in some areas.

Softshell Turtles Potentially Impacted by Reservoir Operations		
Turtle Common Name	Scientific Name	Protection Status
Smooth softshell	<i>Apalone mutica</i>	Species of special state concern
Eastern spiny softshell	<i>A. spinifera spinifera</i>	Species of special state concern
Spiny softshell	<i>A. spinifera</i>	State protected

DTIC QUALITY INSPECTED 4

**DISTRIBUTION STATEMENT A**  
Approved for Public Release  
Distribution Unlimited

19990521 166

**Table 1**  
**Summary of Survey Results, Softshell Turtles**

Species	Protection Status		Divisions Identified	Districts Identified	Number	
	State	Federal			District	Total
Smooth softshell turtle	Species of special state concern		NWD MVD	Omaha Rock Island	1 1	2
Eastern spiny softshell turtle	Species of special state concern	Candidate for Federal protection	LRD	Pittsburgh	2	2
Spiny softshell turtle	State protected		NWD MVD	Omaha Rock Island	2 1	3
Summary			NWD LRD MVD	Omaha Pittsburgh Rock Island	3 2 1	6

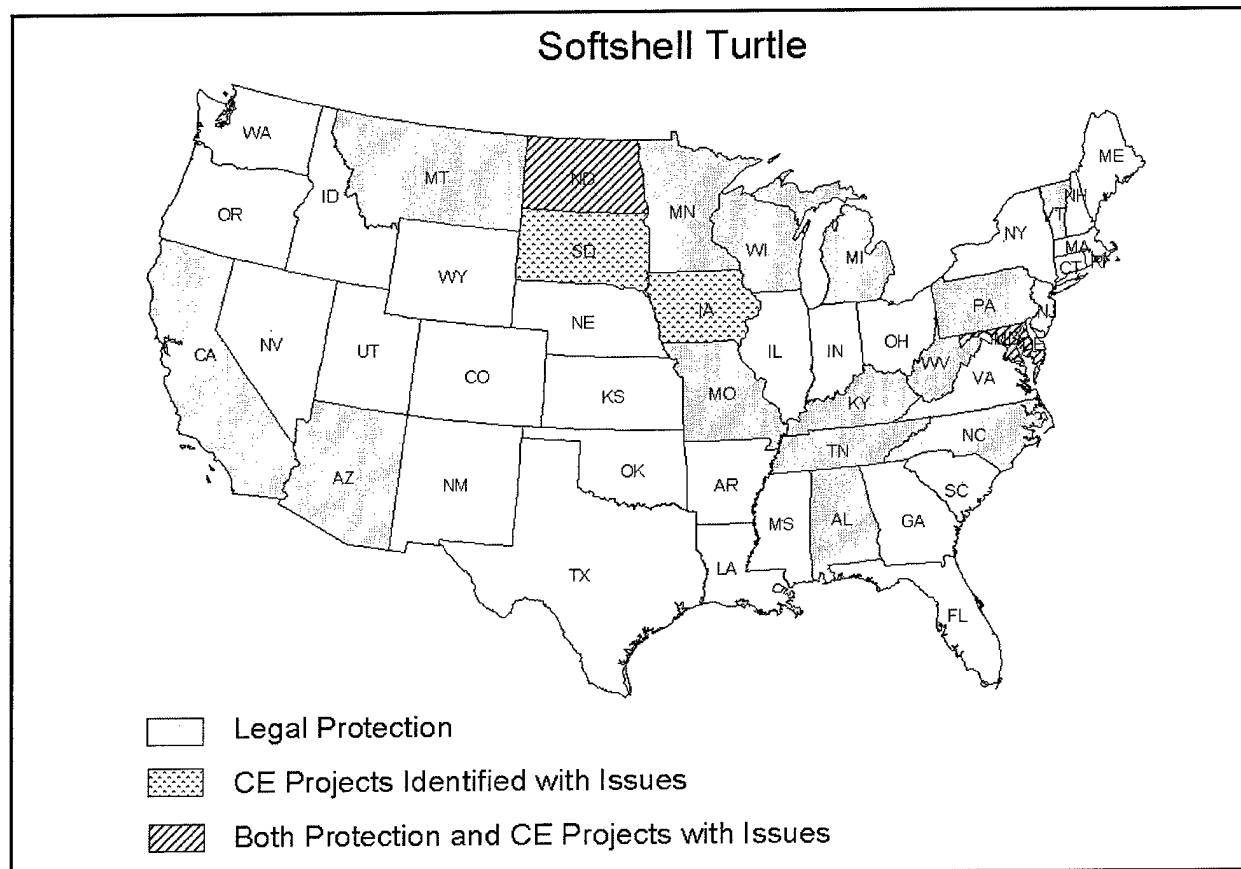


Figure 1. Legal protection status

**Table 2**  
**Turtle Protection Status by Species**

Turtle Species	North Atlantic States												South Atlantic States			
	ME 1/95	NH 1/98	VT 3/98	MA 11/97	CT 95	RI 95	NY 2/97	PA 1/94	NJ 6/96	DE 3/97	MD 11/94	VA 5/92	NC 9/94	SC 1/98	GA 10/97	FL 8/97
Smooth softshell																
Eastern spiny softshell								SSC					SSC			
Spiny softshell			T						SSC							
Florida softshell																

Turtle Species	Midwest States								Southwest States				Pacific States				
	ID 9/97	MT 3/97	WY 1/97	CO 7/95	KS 6/93	NE 5/94	ND 97	SD 3/96	NM 12/97	AZ 1/97	NV 5/94	UT 3/97	CA 3/97	OR 12/96	WA 7/93	HI 1/97	AK 9/93
Smooth softshell							SSC										
Eastern spiny softshell																	
Spiny softshell		SSC								PHR			PHR				
Florida softshell																	

Turtle Species	North Central States											Gulf States						
	KY 11/97	MO 6/97	IA 1/98	MN 7/96	WI 12/97	IN 4/97	IL 94	OH 9/97	MI 6/94	WV 1/97	TX 11/97	LA 1/97	MS 6/96	AL 11/97	OK 4/93	AR 6/96	TN 9/94	
Smooth softshell	SSC	PHR		SSC	PHR				PHR	PHR				PHR			PHR	
Eastern spiny softshell					PHR				PHR	PHR				PHR			PHR	
Spiny softshell		PHR											T	PHR				
Florida softshell														PHR				

FT Federally threatened  
 FC Candidate for Federal protection  
 SSC State species of special concern  
 T or ST State threatened  
 E or SE State endangered  
 PHR Possession and/or harvesting regulations  
 Shading Indicates species with potential issues at CE Reservoirs



Figure 2. Softshell turtle habitat range

**POINT OF CONTACT:** For additional information, contact one of the authors, Ms. Dena D. Dickerson (601-634-3772, [dickerd@ex1.wes.army.mil](mailto:dickerd@ex1.wes.army.mil)), Mr. Kevin J. Reine (601-634-3436, [reinek@ex1.wes.army.mil](mailto:reinek@ex1.wes.army.mil)), or Ms. Kim L. Herrmann (601-634-3689), or the manager of the Ecosystem Management and Restoration Research Program, Dr. Russell F. Theriot (601-634-2733, [therior@ex1.wes.army.mil](mailto:therior@ex1.wes.army.mil)). This technical note should be cited as follows:

Dickerson, D. D., Reine, K. J., and Herrmann, K. L. (1999). "Softshell turtle habitats potentially impacted by USACE reservoir operations," *EMRRP Technical Notes Collection* (TN EMRRP-SI-06), U.S. Army Engineer Research and Development Center, Vicksburg, MS. [www.wes.army.mil/el/emrrp](http://www.wes.army.mil/el/emrrp)

### **Profile: Smooth softshell turtle (*Apalone muticus*)**

**Distribution:** Found in the Ohio River drainage of Ohio, Indiana, and Illinois, the upper Mississippi watershed from Minnesota and Wisconsin, and the Missouri River of the Dakotas south to central Texas. An isolated population occurs in eastern New Mexico.

**Habitat:** Occurs in large rivers and streams with moderate to fast currents. The subspecies (*A. m. muticus*) is also found in lakes, impoundments, and shallow bogs. Waterways with sandy bottoms and a few rocks or aquatic plants are preferred.

**Behavior:** Emerges from hibernation in late March or early April in Kansas, but most annual activity takes place from May through September (Plummer 1976). Winters spent underwater buried in the river bottom. Daily activity is almost entirely diurnal. When not basking, the smooth softshell spends much of its time underwater, buried in the bottom at a depth that allows the snout to reach the surface. Basking occurs on sandy or muddy beaches within a few meters of the water or on logs or rocks (Fitch and Plummer 1975). Smooth softshells are very wary and difficult to approach while basking or nesting, and will quickly retreat to the water when disturbed. When basking on the shore they usually turn to face the water, ready to make a rapid escape. Softshells generally bask alone. Aquatic basking may occur in shallow water. Daily movement is greater in females than in males. Softshells are aggressive toward members of their own species. The smooth softshell is a powerful swimmer. Females tended to occupy both sides of the river, while males typically live on one side (Ernst et al. 1994). Studies by Plummer and Shirer (1975) indicate homing ability.

**Reproduction:** Mating occurs after emergence from hibernation (Plummer and Shirer 1975). Plummer (1977) has observed mating activities in Kansas in April, May, June, and August. The nesting season occurs from late May through July. Nests are excavated with the hind limbs on the high ridges of exposed sandbars (Plummer 1976), banks, and islands in full sunlight. A few nests may, however, be dug in small patches of sand among dense, permanent vegetation. Often nests are in close proximity to one another. Clutches consist of 1-33 eggs (southern distribution) and 18-22 eggs farther north ( $\bar{x}$  range 11-22 eggs per nest). Turtles may lay a smaller second clutch. Incubation period ranges from 65-77 days. Emergence takes place in August or September within the first 3 hr after sunset.

**Food habits:** The smooth softshell is decidedly insectivorous, but other animals and plants are sometimes consumed. Prey includes insects (several species of mostly aquatic and more often larval), fish, adult frogs, tadpoles, mudpuppies, young birds, small mammals, algae, various seeds (e.g., elm, cottonwood), mulberries, and hard nuts (Plummer and Farrar 1981, Williams and Christiansen 1981). Although diet varies geographically, insects may account for 75 percent of items consumed (Ernst et al. 1994). Smooth softshells feed both in and out of water.

**Populations:** Density within some study areas indicates a sex ratio of males to females of 2.5:1. Survival of eggs as a result of submergence, predation, and other hazards varies from year to year. Some studies have indicated that 37 percent of the population is composed of immature individuals.

**Remarks:** *Protection Status:* State species of special concern: Minnesota, North Dakota, and Kentucky; Possession and/or harvesting regulations: Montana, Wisconsin, Michigan, West Virginia, Alabama, and Tennessee.

### **Profile: Spiny softshell turtle (*Apalone spiniferus*)**

**Distribution:** Range extends from western New York, western Pennsylvania, and southern Ontario west to southern South Dakota, Nebraska, and Wyoming, and south to the Gulf coastal states and New Mexico. Disjunct populations occur in Lake Champlain and the lower reaches of the Ottawa River in Vermont, Quebec, and Ontario, and in Montana and Wyoming (Ernst et al. 1994). The spiny softshell has been introduced into Salem County, New Jersey, and the Gila-Lower Colorado River system in Arizona, California, Nevada, Utah, and New Mexico. In California, populations have spread westward from the Colorado River in the irrigation canals of Riverside and Imperial Counties. Other populations occur in the northern parts of Mexico.

**Habitat:** Primarily riverine, but also inhabits marshy creeks, bayous, oxbows, lakes, and impoundments. Prefers areas characterized as soft-bottomed with some aquatic vegetation and nearby sandbars and mud flats. Fallen trees with spreading underwater limbs are frequented. Females seem to prefer open water more than do males (Williams and Christiansen 1981).

**Behavior:** Activity varies geographically. Turtles may be active in all months in their southern range, or if hibernation occurs then emergence may occur as early as March in the southern range or May in the northern range (Ernst et al. 1994). *A. spiniferus* often becomes inactive during September. Adults appear earlier in spring and remain active longer in fall than do juveniles. Daily activity takes place almost entirely during the daylight hours. After darkness, the spiny softshell sleeps buried in the bottom substrate or among the branches of submerged trees. *A. spiniferus* is highly aquatic, spending most of its time in well-oxygenated water, foraging, floating at the surface, or buried in the soft bottom with only the head and neck protruding (Graham and Graham 1991). Spiny softshells spend much time basking on rocks, logs, mud flats, sandbars, or floating debris. When basking on shore, they face the water ready to make a rapid escape. Basking usually occurs alone and rarely begins before 1000 hr. Spiny softshells are aggressive towards members of their own species (Lardie 1965). Orientation mechanisms for long migrations and homing are displayed on clear days, but this ability is lost on overcast days (DeRosa and Taylor 1980; 1982).

**Reproduction:** Mating occurs in April or May. The nesting season begins in late May and lasts to August, but June and July are the peak months. Two clutches of eggs are produced each year (Robinson and Murphy 1978). Clutch size ranges from 4 to 39 eggs, with 12 to 18 being most common (Miller et al. 1989). Nests are dug in full sunlight close to the water, often in adjacent sand or gravel bars. Nesting may occur as far as 100 m inland (Vogt 1981). Nests are dug entirely with the hind limbs, and bladder water may be voided to facilitate digging. In a Wisconsin population, natural incubation ranged from 82-84 days (Ewert 1979). Hatching normally occurs from late August to October, but some hatchlings may overwinter in the nest (Minton 1972). Unlike most other turtle species, with *A. spiniferus* gender determination is not temperature-dependent (Janzen and Paukstis 1991). Sex ratios are essentially 1:1 under a wide range of incubation temperatures.

**Food habits:** The spiny softshell is predominantly carnivorous. Diet consists of numerous insects (both adult and larval), and other invertebrates such as decapods, isopods, and crayfish. Pieces of fish including fingerlings of white crappie (*Pomoxis annularis*) are frequently consumed (Cochran and McConville 1983). Fish remains were found more often in female stomachs, and dragonflies were found more often in male stomachs.

**Populations:** Adult sex ratio for three populations found in Mississippi and Alabama was not significantly different from 1:1 (Vogt and Bull 1982).

**Remarks:** *Protection Status:* Threatened: Vermont; State species of special concern: New Jersey; Maryland, North Carolina, Montana; Possession and/or harvesting regulations: Arizona, California, Montana, Wisconsin, Michigan, West Virginia, Alabama, Tennessee.

## REFERENCES

- Cochran, P. A., and McConville, D. R. (1983). "Feeding by *Trionyx spiniferus* in backwaters of the upper Mississippi River," *Journal of Herpetology* 17:82-86.
- DeRosa, C. T., and Taylor, D. H. (1980). "Homeward orientation mechanisms in three species of turtles (*Trionyx spinifer*, *Chrysemys picta*, and *Terrapene carolina*)," *Behavioral Ecology and Sociobiology* 7:15-23.
- DeRosa, C. T., and Taylor, D. H. (1982). "A comparison of compass orientation mechanisms in three turtles (*Trionyx spinifer*, *Chrysemys picta*, and *Terrapene carolina*)," *Copeia* 1982:394-99.
- Ernst, C. H., Lovich, J. E., and Barbour, R. W. (1994). "Turtles of the United States and Canada," N. P. Dutro, ed., Smithsonian Institution.
- Ewert, M. A. (1979). "The embryo and its egg: Development and natural history," *Turtles: Perspectives and research*. M. Harless and H. Morlock, eds., John Wiley & Sons, New York, 333-413.
- Fitch, H. S., and Plummer, M. V. (1975). "A preliminary ecological study of the soft-shelled turtle *Trionyx muticus* in the Kansas River, Israel," *Journal of Zoology* 24:28-42.
- Graham, T. E., and Graham, A. A. (1991). "*Trionyx spiniferus spiniferus* (eastern spiny softshell). Burying behavior," *Herpetological Review* 22:56-57.
- Janzen, F. J., and Paukstis, G. L. (1991). "A preliminary test of the adaptive significance of environmental sex determination in reptiles," *Evolution* 45:435-40.
- Lardie, R. L. (1965). "Pugnacious behavior in the softshell *Trionyx spinifer pallidus* and implications of territoriality," *Herpetologica* 20:281-84.
- Minton, S. A., Jr. (1972). "Amphibians and reptiles of Indiana," *Indiana Academy Science Monographs* 3:1-346.
- Miller, K., Birchard, G. F., Packard, M. J., and Packard, G. C. (1989). "*Trionyx spiniferus* (spiny softshell turtle). Fecundity," *Herpetological Review* 20:56.
- Plummer, M. V. (1976). "Some aspects of nesting success in the turtle, *Trionyx muticus*," *Herpetologica* 32:353-59.
- Plummer, M. V. (1977). "Reproduction and growth in the turtle *Trionyx muticus*," *Copeia* 1977:440-47.
- Plummer, M. V., and Farrar, D. B. (1981). "Sexual dietary differences in a population of *Trionyx muticus*," *Journal of Herpetology* 15:175-79.
- Plummer, M. V., and Shirer, H. W. (1975). "Movement patterns in a river population of the softshell turtle *Trionyx muticus*," Occasional Paper, Museum of Natural History, University of Kansas (43)1-26.
- Robinson, K. M., and Murphy, G. C. (1978). "The reproductive cycle of the eastern spiny softshell turtle (*Trionyx spiniferus spiniferus*)," *Herpetologica* 34:137-40.
- Vogt, R. C. (1981). "Natural history of amphibians and reptiles of Wisconsin," Milwaukee Public Museum, Milwaukee, WI.
- Vogt, R. C., and Bull, J. J. (1982). "Temperature controlled sex-determination in turtles: Ecological and behavioral aspects," *Herpetologica* 38:156-64.
- Williams, T. A., and Christiansen, J. L. (1981). "The niches of two sympatric softshell turtles, *Trionyx muticus* and *Trionyx spiniferus*, in Iowa," *Journal of Herpetology* 15:303-08.